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(54) REVERSIBLE COMPRESSION CODER AND REVERSIBLE EXPANSION DECODER FOR MOVING IMAGE

(57)Abstract:

PROBLEM TO BE SOLVED: To increase a recording time of an image recorder and to reduce a data transfer rate in the image transmission.

SOLUTION: The reversible compression coder for a moving image is provided with a plurality of Markov models and conditional probability distribution tables (1), (2), (3) used respectively for the models. Entropy coding is applied to a plurality of representative point pixels decided in advance in a frame by using the Markov models and at least one conditional probability table corresponding to them, a conditional probability distribution table used corresponding to the Markov model where bit total numbers (5-1), (5-2), (5-3) as the coding result are minimized (6) is selected (SW1) adaptively in the unit of frames, and all pixels in a frame image which can be subject to entropy coding are entropy-coded.

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CLAIMS

[Claim(s)]

[Claim 1] It has the relative probability distribution table used corresponding to

each of two or more Markov models and these Markov models. Entropy code modulation of two or more representation point pixels as which it was beforehand determined in the frame is carried out using at least one relative probability distribution table used corresponding to each of said two or more Markov models and these Markov models. The relative probability distribution table on which the bit total of this coding result was used corresponding to the Markov model which became min is chosen accommodative per frame. Lossless compression coding equipment of the dynamic image characterized by constituting so that entropy code modulation of all the pixels in which the entropy code modulation in a frame image is possible may be carried out.

[Claim 2] Said relative probability distribution table used in lossless compression coding equipment according to claim 1 corresponding to said Markov model is lossless compression coding equipment of the dynamic image characterized by choosing one from from corresponding to the scene change information on an image while two or more preparations were made corresponding to each Markov model.

[Claim 3] Lossless compression coding equipment of the dynamic image characterized by containing the relative probability distribution table created by said two or more relative probability distribution tables used corresponding to said Markov model based on the image data of a front frame in lossless

compression coding equipment according to claim 2.

[Claim 4] Lossless compression coding equipment of the dynamic image characterized by containing the relative probability distribution table which carried out weighting addition and asked said two or more relative probability distribution tables used corresponding to said Markov model for the relative probability distribution table used for coding of a front frame image, and the relative probability distribution table created based on the image data of a front frame in lossless compression coding equipment according to claim 2.

[Claim 5] It is lossless compression coding equipment of the dynamic image characterized by being the weighting addition which chooses the weighting multiplier calculated based on the formula as which weighting addition of said relative probability distribution table was beforehand determined in lossless compression coding equipment according to claim 4 corresponding to the coded data compressibility of a front frame image accommodative.

[Claim 6] It has at least one relative probability distribution table used corresponding to each of two or more Markov models and these Markov models. It is recorded or transmitted with coded data from a record side or a transmitting side. The model discernment flag which shows whether any of the relative probability distribution table used by the record side or the transmitting side corresponding to a Markov model and it were chosen, and coding was

performed is reproduced or received. Reversible expanding decryption equipment of the dynamic image characterized by decrypting entropy code modulation corresponding to the relative probability distribution table used corresponding to the Markov model and it which are chosen by this playback or the received model discernment flag.

[Claim 7] In reversible expanding decryption equipment according to claim 6 When choosing one from from corresponding to the scene change information on an image while two or more preparations of the relative probability distribution table used corresponding to said Markov model were made in the record side or the transmitting side corresponding to each Markov model, The table discernment flag which shows whether it is a record side, and was recorded with the coded data, or was transmitted by the transmitting side, which relative probability distribution table was chosen by the record side or the transmitting side, and coding was performed is reproduced or received. Reversible expanding decryption equipment of the dynamic image characterized by decrypting entropy code modulation corresponding to the relative probability distribution table chosen corresponding to this playback or the received table discernment flag.

[Claim 8] It is transmitted by the transmitting side and corresponds to the multiplication multiplier obtained in the playback side or the receiving side. in

reversible expanding decryption equipment according to claim 7, with coded data, it is a record side and records -- having -- keeping silence -- Weighting addition of the relative probability distribution table used for the decryption of a front frame image and the relative probability distribution table created based on the image data of a front frame is carried out. Reversible expanding decryption equipment of the dynamic image characterized by decrypting entropy code modulation corresponding to the relative probability distribution table for which it asked.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the lossless compression coding equipment and reversible expanding decryption equipment using a predicting-coding technique especially with respect to the expanding decryption equipment which decrypts the compression coding equipment and the coded data encoded by that cause of a dynamic image (the still picture part may be contained in the dynamic image, of course).

[0002]

[Description of the Prior Art] As compression coding of the conventional image, there is JBIG for JPEG for standardized MPEG for a dynamic image, MPEG 2, and a static image and a quiescence binary image. Although MPEG for compression coding of a dynamic image and MPEG 2 consist of some component engineerings, quantization of the DCT transform coefficient of a two-dimensional discrete cosine transform (DCT) is in those elements. In performing this quantization, by MPEG and MPEG 2, 8 pixel (level) x8 pixel (perpendicular) is made into the smallest unit (block) of coding. DCT is performed to this 8 pixel (level) x8 pixel (perpendicular), and a DCT transform coefficient is computed. It quantizes to this computed DCT transform coefficient. Here, quantization is carrying out division process of the whole DCT transform coefficient with a certain value, and changing into a small value, and, thereby, the compressibility of data can be raised.

[0003] Moreover, in JPEG for compression coding of a static image, irreversible coding whose one of them two kinds of coding is specified and used DCT and a quantization technique, and another are reversible coding which used the predicting-coding technique. First, in irreversible coding based on JPEG, 8 pixel (level) x8 pixel (perpendicular) is made into the smallest unit (block) of coding. DCT is performed to this 8 pixel (level) x8 pixel (perpendicular), and a DCT

transform coefficient is computed. It quantizes to this computed DCT transform coefficient.

[0004] next, lossless compression coding based on JPEG -- the difference of a pixel value and its forecast -- entropy code modulation of the value is carried out. The prediction approach of the pixel value in this lossless compression coding is explained with reference to drawing 1 and Table 1. In drawing 1 , the near pixel which uses x for the pixel for coding and uses a, b, and c for prediction is shown, respectively. Px of Table 1 -- the forecast of the pixel x for coding, and Ra, Rb and Rc -- the sample locations a, b, and c -- each sampled value is shown. Seven forecasts Px shown in Table 1 Some of a fixed number of pixels which were able to define beforehand the prediction machine for which it asks are used choosing them as a unit, and a pixel value is predicted. the technique of entropy code modulation -- first -- the difference of a forecast Px and the pixel value Rx of x -- the method which calculates a value and performs algebraic-sign-ization corresponding to the probability of occurrence, and difference -- there is a method which performs Huffman coding to a value, and the data encoded by these are compressed. About coding of these JPEG, since it is indicated in detail for example, by Chapter 1 "a static-image coding standard" in Yasuda ****** "international standards of multimedia coding" 1991 (Maruzen), please refer to.

[0005]

[Table 1]

1	$Px=Ra$
2	$Px=Rb$
3	$Px=Rc$
4	$Px=Ra+Rb-Rc$
5	$Px=Ra+((Rb-Rc)/2)$
6	$Px=Rb+((Ra-Rc)/2)$
7	$Px=(Ra+Rb)/2$

[0006] Furthermore, coding which combined an image contraction method (PRES), a Markov model, and dynamic algebraic-sign-ization is used for JBIG for coding of a quiescence binary image. The elementary operation of PRES is explained with reference to drawing 2 . First, while PRES makes the image of a low resolution from the image of high resolution, it is a formula, and it explains per this. In drawing 2 , a, b, c, d, e, f, g, h, and i show the pixel of a high resolution image, and W, X, Y, and Z show the pixel of a low resolution picture. It supposes that the pixel values corresponding to a, b, c, d, e, f, g, h, i, W, X, and Y are Pa, Pb, Pc, Pd, Pe, Pf, Pg, Ph, Pi, Pw, Px, and Py, respectively, and the pixel value Pz of the pixel Z at that time is defined by (1), (following 2), and following (3) types.

[Equation 1]

$$SUM = Pe \cdot 4+(Pb+Pd+Pf+Ph) \cdot 2+(Pa+Pc+Pg+Pi) \cdot 1-Pw-(Px+Py) \cdot 3 \quad (1)$$

****** -- carrying out -- the result Case of SUM>=5 Pz=1 (2) Case of SUM<5 Pz=0 (3) ****** -- it determines. Hereafter, the image of a low resolution is made one by one similarly.

[0007] Next, pixel arrangement of the Markov model used for coding by JBIG is shown in drawing 3 (a) - (d). Drawing 3 (a) In - (d), x shows the pixel for coding, and the near pixel on the image of the resolution as a, b, c, d, e, andx with same f, and G, H, I, and J show the pixel of a low resolution picture. This x and physical relationship of G, H, I, and J have four kinds of cases, as shown in drawing 3 (a) - (d), respectively, and they are called the phase 0, the phase 1, the phase 2, and the phase 3, respectively.

[0008] Thus, in JBIG, it considers as 212 kinds of conditions including the phase based on the location of the pixel value (6 pixels of a, b, c, d, e, and f on the same high resolution image as x of near, and 4 pixels on a low resolution picture) of G, H, I, and J, and the pixel x for coding for a Markov model, algebraic-sign-ization is performed based on the relative probability distribution table, and it is made to compress data. Moreover, also about coding of JBIG, since it is indicated in detail for example, by Chapter 2 "binary coding" in Yasuda ****** "international standards of multimedia coding" 1991 (Maruzen), please refer to.

[0009]

[Problem(s) to be Solved by the Invention] As mentioned above, irreversible coding of JPEG for MPEG for the conventional dynamic-image compression coding, MPEG 2, and static-image compression coding uses the technique of quantization of a DCT multiplier, in order to raise compressibility. However, when it encoded using the quantization technique of this DCT multiplier, even if it performed the data decryption about that coded data, it is impossible for it to only be decrypted by the value approximated to the data of a basis, and to return to the data of a basis itself. Therefore, when these techniques are used for coding of an image, it becomes what is different with the image before coding, and the image after encoding and decrypting the coded data.

[0010] Moreover, although it is coding for the lossless compression of a still picture, JPEG for the conventional static-image compression coding is not coding for which were suitable, in order to process per frame, for example, when there is a motion by the interlaced image. Moreover, in using the optimal table for coding of each frame as a probability-distribution table used for entropy code modulation, it is necessary to transmit and has brought record or a result to which the amount of data is made to increase with the coded data in the table itself. Moreover, when not using the optimal table for each frame, compressibility is stopped low.

[0011] Moreover, although JBIG for quiescence binary picture compression

coding is coding for the lossless compression of a binary image, in order to apply this coding method to the image of a continuous tone, big memory is needed and it becomes difficult to mount [of equipment] it.

[0012] The purpose of this invention is to offer the lossless compression coding equipment and decryption equipment of a dynamic image from which each trouble mentioned above was removed.

[0013]

[Means for Solving the Problem] When two or more Markov models are specified, and what has the highest coding effectiveness is chosen accommodative per frame and carries out entropy code modulation out of the relative probability distribution table used corresponding to each Markov model, he compresses without being missing in dynamic-image data, and is trying to raise the compressibility of dynamic-image data moreover in the lossless compression coding equipment of the dynamic image by this invention, in order to attain the above-mentioned purpose.

[0014] Moreover, he makes the relative probability distribution table which updated the above-mentioned relative probability distribution table used for entropy code modulation per frame, and fitted the frame to encode, and is trying to raise the data compression rate of a dynamic image further in this invention.

[0015] Namely, the lossless compression coding equipment of the dynamic

image by this invention It has the relative probability distribution table used corresponding to each of two or more Markov models and these Markov models. Entropy code modulation of two or more representation point pixels as which it was beforehand determined in the frame is carried out using at least one relative probability distribution table used corresponding to each of said two or more Markov models and these Markov models. It is characterized by having chosen the relative probability distribution table on which the bit total of this coding result was used corresponding to the Markov model which became min accommodative per frame, and constituting so that entropy code modulation of all the pixels in which the entropy code modulation in a frame image is possible may be carried out.

[0016] Moreover, the lossless compression coding equipment of the dynamic image by this invention is characterized by said relative probability distribution table used corresponding to said Markov model choosing one from from corresponding to the scene change information on an image, while two or more preparations were made corresponding to each Markov model.

[0017] Moreover, the lossless compression coding equipment of the dynamic image by this invention is characterized by containing the relative probability distribution table created based on the image data of a front frame in said two or more relative probability distribution tables used corresponding to said Markov

model.

[0018] Moreover, the lossless compression coding equipment of the dynamic image by this invention is characterized by containing the relative probability distribution table which carried out weighting addition and asked for the relative probability distribution table used for coding of a front frame image, and the relative probability distribution table created based on the image data of a front frame in said two or more relative probability distribution tables used corresponding to said Markov model.

[0019] Moreover, the lossless compression coding equipment of the dynamic image by this invention is characterized by being the weighting addition as which weighting addition of said relative probability distribution table chooses the weighting multiplier calculated based on the formula beforehand defined corresponding to the coded data compressibility of a front frame image accommodative.

[0020] Moreover, the reversible expanding decryption equipment of the dynamic image by this invention It has at least one relative probability distribution table used corresponding to each of two or more Markov models and these Markov models. It is recorded or transmitted with coded data from a record side or a transmitting side. The model discernment flag which shows whether any of the relative probability distribution table used by the record side or the transmitting

side corresponding to a Markov model and it were chosen, and coding was performed is reproduced or received. It is characterized by decrypting entropy code modulation corresponding to the relative probability distribution table used corresponding to the Markov model and it which are chosen by this playback or the received model discernment flag.

[0021] Moreover, the reversible expanding decryption equipment of the dynamic image by this invention When choosing one from from corresponding to the scene change information on an image while two or more preparations of the relative probability distribution table used corresponding to said Markov model were made in the record side or the transmitting side corresponding to each Markov model, The table discernment flag which shows whether it is a record side, and was recorded with the coded data, or was transmitted by the transmitting side, which relative probability distribution table was chosen by the record side or the transmitting side, and coding was performed is reproduced or received. It is characterized by decrypting entropy code modulation corresponding to the relative probability distribution table chosen corresponding to this playback or the received table discernment flag.

[0022] Moreover, the reversible expanding decryption equipment of the dynamic image by this invention It is transmitted by the transmitting side and corresponds to the multiplication multiplier obtained in the playback side or the receiving side.

with coded data, it is a record side and records -- having -- keeping silence -- It is characterized by decrypting entropy code modulation corresponding to the relative probability distribution table which carried out weighting addition and asked for the relative probability distribution table used for the decryption of a front frame image, and the relative probability distribution table created based on the image data of a front frame.

[0023]

[Embodiment of the Invention] With reference to an accompanying drawing, this invention is explained at a detail based on the gestalt of implementation of invention below. Although two or more Markov models are specified, and what has the highest coding effectiveness is chosen accommodative per frame and is carrying out entropy code modulation in this invention out of the relative probability distribution table corresponding to each Markov model and it as mentioned above With the gestalt of the following operations, in order to make a configuration easy, the Markov model formed from 3 pixels in which it of three kinds such as a Line model, a Frame model, and a Field model also included 2 pixels near the pixel for coding shall be specified.

[0024] the level of the pixel whose level of the pixel first encoded with coding by the Markov model formed from 3 pixels is two, Xa and its near, -- Xb and Xc it is -- a case -- Xa an occurrence probability -- Xb and Xc It supposes that it is the

double Markov information source for which it depends, and relative probability P (Xa |Xb and Xc) is defined. Here, they are Xa, Xb, and Xc. If the values from 0 to 255 shall be taken, 65,536 kinds of number of the combination of (Xb and Xc) exists, respectively. It is Xa to each (Xb and Xc) of this. The probability distribution when considering as a parameter is defined. Therefore, (Xb and Xc) are fixed and it is Xa. The grand total of the probability at the time of making it change from 0 to 255 is set to 1. Based on this relative probability distribution, entropy code modulation, such as algebraic-sign-izing and Huffman coding, is performed. This entropy code modulation is lossless compression coding without lack of data.

[0025] Coding by each Markov model of the Line model used for below with the gestalt of operation of this invention, a Frame model, and a Field model is explained. Drawing 4 shows the 3-pixel arrangement used for a Line model, and is Xpi. The pixel to encode and Xpi-1, and Xpi-2 Xpi The same scanning-line up pixel which is before one and two, respectively is shown. Line Markov model coding is coding which performs Markov model coding by the pixel on the same scanning line, and it carries out using three pixels shown in drawing 4 , Xpi, Xpi-1, and Xpi-2. Pixel Xpi to encode Level Xi An occurrence probability is level Xi-1 of pixel Xpi-1. Pixel Xpi-2 Level Xi-2 It supposes that it is the double Markov information source for which it depends, the relative probability distribution P (Xi

|Xi-2 and Xi-1) is generated, and entropy code modulation is performed based on this probability distribution. In this coding, coding of the 1st on each scanning line in a frame and the 2nd pixel is not performed. These pixels are because two nearby pixels do not gather completely.

[0026] Drawing 5 shows the 3-pixel arrangement used for a Frame model, and is Xpi. The pixel and Xpi-1 to encode Xpi The pixel in front of [of an on / the same scanning line] one, and Xpi-h Xpi The pixel in the same train on the scanning line in front of one is shown. Three pixels on the scanning line indicated to be Frame Markov model coding to drawing 5 , Xpi, Xpi-1, and Xpi-h It is Markov model coding performed by using. Pixel Xpi to encode Level Xi An occurrence probability is pixel Xpi-h. Level Xi-h Pixel Xpi-1 Level Xi-1 It is supposed that it is the double Markov information source for which it depends. The relative probability distribution P (Xi |Xi-h and Xi-1) is generated, and entropy code modulation is performed based on this probability distribution. For the same reason as the case of a Line model, coding of all the pixels on the 1st scanning line in a frame and the 1st pixel on the other scanning line is not performed by this coding.

[0027] Drawing 6 shows the 3-pixel arrangement used for a Field model, and is Xpi. The pixel and Xpi-1 to encode Xpi The pixel in front of [of an on / the same scanning line] one and Xpi-2h are Xpi. The pixel in the same train on the

scanning line in front of two is shown. Three pixels on the scanning line indicated to be Field Markov model coding to drawing 6 , They are Xpi, Xpi-1, and Markov model coding using Xpi-2h. Pixel Xpi to encode Level Xi An occurrence probability is level Xi-2h of pixel Xpi-2h, and pixel Xpi-1. Level Xi-1 It is supposed that it is the double Markov information source for which it depends. The relative probability distribution P (Xi |Xi-2h and Xi-1) is generated, and entropy code modulation is performed based on this probability distribution. For the same reason as the case of a Line model, coding of all the pixels on the 1st scanning line in a frame and the 2nd scanning line and the 1st pixel on the other scanning line is not performed by this coding.

[0028] Although explanation of coding by each Markov model of a Line model, a Frame model, and a Field model is finished above, as mentioned above, out of each Markov model of them, and the relative probability distribution table corresponding to it, this invention chooses per frame what has the highest coding effectiveness accommodative, carries out entropy code modulation, shows two kinds of examples of a configuration for it to drawing 7 and drawing 8 , and explains them per this.

[0029] In drawing 7 , 1, 2, and 3 are circuits which perform the above-mentioned coding which followed the Line model, the Frame model, and the Field model, respectively. The result of coding by each [these] circuits 1, 2, and 3 While

carrying out one-frame period delay of each, for example, supplying the one-frame delay circuit 4-1 constituted by the frame memory etc., 4-2, and 4-3, respectively The representation point selection circuitry 5-1 which extracts the coding result of the time location equivalent to the representation point selected several places in one frame from the result of coding by circuits 1, 2, and 3, 5-2, and 5-3 (the location of a representation point -- each -- it is the same) are supplied, respectively. The number of bits of coding for every model is made to output.

[0030] It is the number of bits for every model obtained by this among drawing

[Outside 1]

Σ

It comes out, total is taken per frame with the shown summing amplifier, respectively, a comparator 6 compares the result of the total, and the model selection information for choosing the model which generates the minimum bit is made to output. From the one-frame delay circuit 4-1, 4-2, and 4-3, one coding result of having followed the three above-mentioned models is delayed, is outputted, and is supplied to each contact of a changeover switch SW1. Since the selected position of a changeover switch SW1 is determined by the above-mentioned selection information, the coding output of what has the

highest coding effectiveness (what has the highest data compression rate) will be obtained by the output side of this switch SW1 among the three above-mentioned models.

[0031] In addition, when the number of bits becomes the same as a result of the comparison in a comparator 6, the pixel which does not encode chooses the model defined beforehand, such as choosing the minimum Line model. Moreover, although the representation point is defined in advance, the number of a representation point is made [many / as possible], and the location of each representation point needs making it distribute so that there may be no bias within a frame.

[0032] Moreover, the 2nd example of a configuration of this invention equipment which chooses per frame what has the highest coding effectiveness accommodative, and carries out entropy code modulation out of a Markov model and the relative probability distribution table corresponding to it is shown in drawing 8 , and it explains per this. In addition, the same sign is attached and shown in the part where the same circuit element as having been shown in drawing 7 is used among drawing 8 , and explanation of these circuit elements is omitted.

[0033] In this example of a configuration, first, a picture signal input is dichotomized and the signal which is equivalent to a representation point in the

dichotomous picture signal input is supplied to the representation point selection circuitry 5 and the one-frame delay circuit 4 which are outputted alternatively, respectively. Subsequently, the coding network 1-1 which performs coding which followed the Line model, the Frame model, and the Field model in the output of the representation point selection circuitry 5, 2-1, and 3-1 are supplied, and the coding output in the representation point of each model (Line, Frame, and Field) of every is obtained. By taking total with the summing amplifier in which the coding output is crossed to one frame, and is shown by [outside 1], supplying a comparator 6 further, and carrying out the size comparison of the number of bits, the model selection information for choosing the model which generates the same minimum bit as the case of drawing 7 is obtained.

[0034] On the other hand, the picture signal input supplied to the frame delay circuit 4 is supplied to the coding network 1-2 which serves as a signal which was overdue one frame, and encodes every model through a changeover switch SW 1-1, 2-2, and 3-2. The changeover switch SW 1-1 of illustration and SW 1-2 interlock, and are changed, the output, i.e., the model selection information, of a comparator 6, and the coding output encoded with the model with which coding effectiveness becomes the highest is obtained from the changeover switch SW 1-2 of the output side.

[0035] When carrying out the record or transmission of coded data encoded as

mentioned above, 2 bits per frame of model discernment flags which show whether it encoded by using which model among a Line model, a Frame model, and a Field model in addition to the coded data are needed. Moreover, since the pixel which does not encode to each model exists as mentioned above, as for these pixels, a pixel value will be recorded or transmitted as it is. Although these data make the amount of signs increase and the compressibility of coded data is reduced, since there is very much image amount of data, even if there is an increment in the amount of data by the pixel by which the amount of data for a model discernment flag is not increased and encoded, in a common television picture, a data compression rate is not greatly degraded by model change coding of this invention, for example.

[0036] Next, the coded data encoded by the lossless compression coding equipment of the dynamic image by this invention explained above is recorded on a record medium, or it is transmitted through a transmission line, and the reversible expanding decryption equipment by this invention decrypted by the time of playback or the receiving side, respectively is explained. On the occasion of a decryption, first, the above-mentioned model discernment flag which shows which model is used and encoded at the time of coding is read, next either a Line model, a Frame model and a Field model are decrypted according to the flag.

[0037] The method of the decryption for every model is explained. In a Line

model, the 3rd pixel on the same scanning line is decrypted on the basis of the 1st on each scanning line recorded or transmitted first, without encoding, and the 2nd pixel. Next, the 4th pixel is similarly decrypted on the basis of the 2nd pixel and the 3rd pixel decrypted previously. A decryption of all pixels is attained by repeating this decryption.

[0038] Moreover, in a Frame model, the 2nd pixel on the 2nd scanning line is decrypted on the basis of the 2nd pixel on the 1st scanning line recorded or transmitted first, without encoding, and the 1st pixel on the 2nd scanning line. Next, the 3rd pixel on the 2nd scanning line is similarly decrypted on the basis of the 3rd pixel on the 1st scanning line, and the 2nd pixel on the 2nd scanning line decrypted previously. After performing this decryption to the pixel of the last on the 2nd scanning line, the pixel on the 3rd scanning line is decrypted in the same procedure. Similarly, a decryption of the pixel on other scanning lines is repeated, and a decryption of all the pixels in a frame is attained.

[0039] Moreover, in a Field model, the 2nd pixel on the 3rd scanning line is decrypted on the basis of the 2nd pixel on the 1st scanning line recorded or transmitted first, without encoding, and the 1st pixel on the 3rd scanning line. Next, the 3rd pixel on the 3rd scanning line is similarly decrypted on the basis of the 3rd pixel on the 1st scanning line, and the 2nd pixel on the 3rd scanning line decrypted previously. After performing this decryption to the pixel of the last on

the 3rd scanning line, the pixel on the 5th scanning line is decrypted in the same procedure. Similarly, a decryption of the pixel on the scanning line of other odd numbers is repeated. A decryption of the pixel on the scanning line of an even number decrypts the 2nd pixel on the 4th scanning line first on the basis of the 2nd pixel on the 2nd scanning line, and the 1st pixel on the 4th scanning line. Next, the 3rd pixel on the 2nd scanning line, The 3rd pixel on the 4th scanning line is similarly decrypted on the basis of the 2nd pixel on the 4th scanning line decrypted previously. After performing this decryption to the pixel of the last on the 4th scanning line, the pixel on the 6th scanning line is decrypted in the same procedure. Similarly, a decryption of the pixel on the scanning line of other even numbers is repeated. A decryption of all the pixels in a frame is attained according to this activity.

[0040] Although three kinds of Markov model coding, a Line model, a Frame model, and a Field model, is performed above and what has the highest coding effectiveness was chosen from the inside, it cannot be overemphasized that two or more Markov models of the arbitration which the Markov model which makes the lossless compression coding equipment of the dynamic image by this invention applicable to selection is not restricted to the three above-mentioned models, and is considered to be suitable may be used.

[0041] Next, in this invention, although premised on performing entropy code

modulation to a coding side using a Markov model and a corresponding relative probability table, since the procedure of coding and a decryption is not essential to this invention, suppose the detail that for example, Hiroshi Harashima work "image information compression" (Ohm-Sha, August 25, Heisei 3 issue) is yielded.

[0042] Moreover, although the relative probability distribution table used for entropy code modulation is based on having in [one] an encoder and a decryption machine beforehand as a default table (Default Table) which is mentioned later, for example, it becomes possible [raising compressibility] by preparing two or more relative probability distribution tables to one Markov model, and changing these for every frame based on the so-called scene change information. In this case, it is effective about one of two or more relative probability distribution tables to compound this for every frame so that it may state below.

[0043] One operation gestalt of this invention constituted so that it faced, and a table might be changed and one might be chosen for performing entropy code modulation for this purpose from the relative probability distribution tables by which two or more preparations were made corresponding to the scene change information on an image is shown in drawing 9 . In drawing 9 , as for a default table (Default Table) and 8, a new table (New Table) and 11 are one-frame delay

circuits, and a unique table (Unique Table) and 9 give [7 / an old table (Old Table) and 10] explanation of each circuit element and overall actuation to below.

[0044] the thing of the initial probability-distribution table used for entropy code modulation in the default table (Default Table) 7 -- it is -- relative probability Pd (Xa |Xb and Xc) (however, level of the pixel of Xa and its near is set to Xb and Xc for the level of the pixel to encode) -- all Xa(s), Xb, and Xc ******** -- it is specified. Although this table will not be cared about though it is what kind of probability distribution if the following conditions 1 are satisfied, it is desirable that it is a table with the versatility from which the compressibility of extent set to coding of what kind of image is obtained. For example, occurrence distribution is searched for not from a scene change and a series of images between scene changes but from the image which is about 20 kinds which are mutually unrelated, and the occurrence frequency of the occurrence distribution transposes the part of 0 to the occurrence frequency 1. In this way, under the following conditions 1, relative probability Pd (Xa |Xb, Xc) is defined based on the reconfigurated occurrence distribution, and it is Default Table about this. By carrying out, it is possible to make a flexible table.

[Equation 2]

条件1

任意のX_a, X_b, X_cについて　$Pd(X_a \mid X_b, X_c) \neq 0$　(4)

すべてのX_b, X_cについて　$\sum_{X_a} Pd(X_a \mid X_b, X_c) = 1$　(5)

[0045] a unique table (Unique Table) -- the thing of the probability-distribution table which searched for occurrence distribution from the i-1st frame images in front of one of them, and was made based on the occurrence distribution supposing the frame number of the frame image which is going to carry out current coding was i in 8 -- it is -- this -- all Xa(s), Xb, and Xc ******** -- relative probability Pu (Xa |Xb and Xc) is specified. However, with the i-1st frame images, they are all Xa(s), Xb, and Xc. It has not necessarily occurred. Therefore, this table has satisfied the following conditions 2, and even if the part from which a probability is set to 0 exists, it does not interfere.

[Equation 3]

条件2

X_b, X_cを固定した場合、すべてのX_aについて

$Pu(X_a \mid X_b, X_c) = 0$ならば

$$\sum_{X_a} Pu(X_a \mid X_b, X_c) = 0 \qquad (6)$$

X_b, X_cを固定した場合、あるX_aについて

$Pu(X_a \mid X_b, X_c) \neq 0$ならば

$$\sum_{X_a} Pu(X_a \mid X_b, X_c) = 1 \qquad (7)$$

[0046] In the old table (Old Table) 9 It is the thing of the table used for coding of

the i-1st frame images, and is DefaultTable by coding of the i-1st frame images. When using it Default Table The same Table Table which became and was compounded by coding of the i-1st frame images It is Table used for coding of the i-1st frame images when using it. The same Table It becomes. this probability-distribution table -- all Xa(s), Xb, and Xc ******** -- relative probability Po (Xa |Xb and Xc) is specified, and the following conditions 3 must be satisfied.

[Equation 4]

条件 3

任意の X_a, X_b, X_c について $P_o(X_a \mid X_b, X_c) \neq 0$ (8)

すべての X_b, X_c について $\sum_{X_a} P_o(X_a \mid X_b, X_c) = 1$ (9)

[0047] In the new table (New Table) 10, it is the thing of the probability-distribution table used for coding of the i-th frame image, and is Default Teble to coding of the i-th frame image. It is Default Table when using it. The same Table It becomes and is Default Table. It is Old Table when not using it. It becomes the new probability-distribution table made by two composition of Unique Table made from the i-1st frame images. this probability-distribution table -- all Xa(s), Xb, and Xc ******** -- relative probability Pn (Xa |Xb and Xc) is specified, and the following conditions 4 must be satisfied.

[Equation 5]

条件4

任意のX_a, X_b, X_c について　$Pn(X_a \mid X_b, X_c) \neq 0$　(10)

すべてのX_b, X_c について　$\sum_{Xa} Pn(X_a \mid X_b, X_c) = 1$　(11)

[0048] It is [outside 2] among drawing 9 .

⊕

The adder come out of and shown is Composition Table. Unique Table and Old Table at the time of making A synthetic operation is performed. This composition Table The creation approach of the relative probability distribution Pn (Xa |Xb and Xc) ** Pu (Xa |Xb and Xc) of Unique Table -- setting -- Xb and Xc fixing -- All Xa(s) ******** -- case where it is Pu(Xa |Xb and Xc) =0 All Xa(s) It receives. Pn(Xa |Xb and Xc) =Po (Xa |Xb and Xc) (12) -- Pu (Xa |Xb and Xc) of ** Unique Table -- setting -- Xb and Xc fixing -- A certain Xa ******** -- case where it is Pu(Xa|Xb and Xc) !=0 All Xa(s) It receives. Pn (Xa | Xb and Xc) =k1 and Po(Xa | Xb and Xc)+k2 - Pu (Xa | Xb and Xc) (13) It carries out. In addition, it is Composition Table even when this updating is performed. The above-mentioned conditions 1 ((4), (5) types) are satisfied.

[0049] It is k1 and k2 here. Composition Table In case it creates, it is the multiplication multiplier to be used, and the following conditions 5 are fulfilled.

Conditions 5 k1+k2 =1 0<k1 <=1 0 <=k2 <1 (14) k1 and k2 As long as it fulfills

conditions 5, any value is sufficient, but in case the i-th frame image is encoded, a setup to which the amount of signs becomes min is desirable. For example, the following (15), (16), It determines by the approach of (17) and (18) types.

[Equation 6]

$$N' = \frac{Ntotal}{Npixel \times Nbit} \qquad (15)$$

It carries out and is [Equation 7].

① $N' < 0.3506$ の場合

$$k_2 = 0.999 \qquad (16)$$

② $0.3506 \leqq N' < 0.95$ の場合

$$k_2 = \frac{0.95 - N'}{0.6} \qquad (17)$$

③ $0.95 \leqq N'$ の場合

$$k_2 = 0.0 \qquad (18)$$

However, the number of pixels for one frame and Nbit of the total amount of signs at the time of Ntotal encoding the i-1st frame images and Npixel are the numbers of bits per pixel before coding.

[0050] Moreover, the one-frame delay circuit 11 is delayed in the signal for one frame. An image changes extremely in an animation like the point editing [image], and a changeover switch SW2 is Default Table in a part with inter-frame small correlation. To a side, not the point editing [image] but inter-frame correlation compounds in a very large part again. It changes to the

Table side. This change can be changed by detecting a scene change.

[0051] Table compounded when the coded data obtained on these relative probability distribution tables was recorded or transmitted Whether it is used and Default Table The table discernment flag which shows whether it is used, and composition Table When using it, it is k1 for composition. Or k2 One of multiplication multiplier data is still more nearly required. However, since there is very much usual image amount of data, even if the amount of data increases only the part of these tables discernment flag and multiplication multiplier data, these have it as compared with the amount of data for images, and it does not degrade the compressibility of this change method greatly. [very little]

[0052] The table discernment flag which shows first the probability-distribution table currently used at the time of coding by decryption of the coded data encoded by the above change method is read in coded data, and it is Default Table. Whether it is used and composition Table It investigates whether it is used. It is Default Table. Default Table with which the decryption machine was equipped as it was when it became clear that it is used It decrypts by using. It is Composition Table. When it becomes clear that it is used, it is coded data to the multiplication multiplier data k1. Or k2 It reads and is the composition Table for a decryption. It creates and is Composition Table. It decrypts by using. At this time, it is Composition Table. The creation approach is the same as the creation

approach of the composition Table in the case of coding.

[0053] Finally, the configuration of other operation gestalten of a change method is shown in drawing 10 . In drawing 10 , the same sign is attached and shown in the same part as the circuit element in drawing 9 . moreover, SW3 which is not shown in drawing 9 -- inter-frame -- difference -- it is the changeover switch to which a change is performed using information. the advantage to which coding compressibility becomes [the direction where Uniqne Table is used for this operation gestalt as it is in the still picture part which the same image follows] high -- employing efficiently -- inter-frame difference -- based on information (refer to drawing 10), a synthetic table (Unique Table and Old Table) and Unique Table are changed. Moreover, what is necessary is just to make it decrypt in this case using Uniqle Table based on the table discernment flag which shows Unique Table by the decryption side.

[0054]

[Effect of the Invention] It becomes possible to raise compressibility by carrying out compression coding, without being missing in dynamic-image data according to the lossless compression coding equipment of the dynamic image by this invention, and updating the relative probability distribution table which moreover uses two or more Markov models, changing them accommodative and which is used for a Markov model for every frame, as explained above. When this uses

this invention for record or transmission, it becomes reducible [the image amount of data recorded or transmitted, respectively], therefore the chart lasting time of image recording equipment is made to increase, and it becomes possible to reduce the data transfer rate in picture transmission.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The prediction approach of the pixel value in lossless compression coding based on JPEG is shown.

[Drawing 2] The image contraction method (PRES) in coding based on JBIG is shown.

[Drawing 3] Pixel arrangement of the Markov model used for coding by JBIG is shown.

[Drawing 4] The 3-pixel arrangement used for the Line model which is one of the Markov models used with the gestalt of operation of this invention is shown.

[Drawing 5] The 3-pixel arrangement used for the Frame model which is one of the Markov models used with the gestalt of operation of this invention is shown.

[Drawing 6] The 3-pixel arrangement used for the Field model which is one of the

Markov models used with the gestalt of operation of this invention is shown.

[Drawing 7] The block diagram shows the configuration in the gestalt of operation of the lossless compression coding equipment of the dynamic image by this invention.

[Drawing 8] The block diagram shows other configurations in the gestalt of operation of the lossless compression coding equipment of the dynamic image by this invention.

[Drawing 9] One operation gestalt of this invention constituted so that a table might be changed and one might be chosen to the scene change information on an image from the relative probability distribution tables by which two or more preparations were made is shown.

[Drawing 10] The same configuration of other operation gestalten of a change method is shown.

[Description of Notations]

1, 1-1, 1-2 Coding network according to a Line model

2, 2-1, 2-2 Coding network according to a Frame model

3, 3-1, 3-2 Coding network according to a Field model

4-1, 4-2, and 4- 3 and 4 One-frame delay circuit

5-1, 5-2, and 5- 3 and 5 Representation point selection circuitry

6 Comparator

7 Default Table (Default Table)

8 Unique Table (Unique Table)

9 Old Table (Old Table)

10 New Table (New Table)

11 One-Frame Delay Circuit

SW1, SW 1-1, SW 1-2, SW2, SW3 Changeover switch